APPARATUS AND METHOD FOR MANUFACTURING HOLDERS, IN PARTICULAR CRATES

The invention relates to a mold for manufacturing holders. The invention further relates to a method for manufacturing holders.

As a rule, the injection molding of holders such as crates in molds takes place on relatively large, heavy presses, which is expensive and requires much space. A further drawback of the known holders is that the wall thicknesses of the different parts thereof will be relatively great, as, otherwise, no suitable ratio between on the one hand, flow path length and flow path cross section and, on the other hand, flow path length and melt of the plastic is obtained. Upon reduction of the wall thickness, the injection pressure for the plastic will need to be increased, while the closing pressure required for keeping the mold closed will increase further. A further drawback of this known method is that cavities in the holder such as, for instance, in hollow wall parts and the like are virtually not possible, in particular with small wall thickness, since the required solid cores will not be able to resist the pressure built up by the injected plastic in the mold and will bend, break and/or will become damaged in a different manner, while, furthermore, often, problems in clearance will occur.

It is an object of the invention to provide a mold for forming plastic holders such as crates, containers and the like, whereby at least a number of the drawbacks mentioned of the known mold and the method to be used therewith are obviated.

In particular, the invention aims to provide such a mold with which thin-walled holders can be formed, more in particular thin-walled holders with, at least partly, hollow wall parts.

A further object of the invention is to provide a mold with which the plastic can be introduced into the mold with relatively low pressure, which mold can be kept closed with relatively low closing pressure. In particular, the

invention aims to provide such a mold with which holders with relatively long, complex flow paths can be formed.

A further object of the invention is to provide a mold with which holders can be formed having small clearance angles, which holders have a relatively great depth relative to their bottom surface.

Furthermore, the invention contemplates providing a method for manufacturing plastic holders such as crates, containers and the like, with which, with relatively low injection pressures and/or closing pressures, holders can be manufactured, in particular holders with complex structure, long, narrow flow paths and/or, at least partly, hollow walls.

The invention further aims to provide such a method with which different types of plastic can be processed, in particular also low melt plastics, with which, moreover, transparent, opaque as well as completely non-transparent holders can be manufactured.

In order to achieve at least a number of the above-mentioned and other objects, a mold according to the invention is characterized by the features of claim 1.

By using one or more moveable wall parts of a mold cavity in the mold, the advantage is achieved that at least upon injection of the plastic into the mold, the mold cavity has a relatively great volume, with few restricting passageways. Therefore, during injection, the flow paths will be relatively short, while the passageways the plastic has to travel are relatively large. As a result, the plastic can be introduced into the mold with relatively little pressure. Only when the plastic has been introduced into the mold cavity at least in part, then, during use, the or each moveable wall part is moved in the direction of an opposite wall part, so that the respective passageway is reduced. The plastic between the respective moveable wall part and the opposite wall part is then somewhat compressed and/or forced away to a part of the mold cavity located further away. Therefore, each time, the flow front of the plastic is shifted upon movement of the or each moveable wall part, so that

the plastic is forced away, each time over a flow path matching the respective melt and passage opening of the flow path.

With a mold according to the invention, the, at least one moveable wall part is moved in a direction of movement including an angle with the direction of movement for opening and closing the mold. Usually, this latter will substantially coincide with the pressing direction of a press to be used with the mold, at least with the direction of pressure for the closing pressure. By having the or each moveable wall part move in the second direction of movement, wall parts can be formed which do not extend at right angles to the first direction of movement. Thus, for instance, sidewall parts of the holder can be formed when a bottom surface of the holder is approximately at right angles to the first direction of movement. With this, also, the important advantage is achieved that the load on the optional core parts in a direction including an angle with the first direction of movement can be considerably reduced, which is advantageous in particular when using relatively thin core parts as intended for forming partly hollow wall parts, channels and the like.

Herein, including an angle is understood to mean that the first and the second direction of movement are not parallel to each other. Preferably, the directions of movement include an angle of between 20° and 90°, more preferably between 45° and 90° and most preferably between 60° and 90°. As a result, a favorable load for the different parts is obtained. In a special embodiment, a mold according to the invention is characterized in that the first and second direction of movement are approximately at right angles to each other. Consequently, simple and advantageous movements of the two mold parts and of the or each moveable wall part are obtained as well as favorable loading thereof, in particular of core parts thereof.

In a mold according to the invention, two or more moveable wall parts can be provided, preferably such that they move from different sides of one or more core parts towards each other. By providing core parts in the mold, cavities in the holders to be formed can be provided.

In a particularly advantageous embodiment, a mold according to the invention is further characterized by the features of claim 7.

With a central core part, a main space of the holder can be formed in a simple manner. By placing one or more second core parts therearound, at a short distance therefrom, additional spaces can be formed, for instance in one or more longitudinal wall parts. Then, between the central core part and a respective adjoining second core part, for instance, a first wall of a longitudinal wall part can be formed, at the opposite side of the second core part a second wall thereof, between the second core part and the moveable wall part. Since this moveable wall part can first be brought into a retracted position and only when therebetween plastic has been introduced, is moved forward in the direction of the second core part, the plastic can simply flow between the two parts. Premature solidification or stagnating flow is prevented where necessary. Thus, thin walls of a hollow longitudinal wall or a part thereof can be obtained. The fact is that when opening the mold and taking the product out, the core parts will remain behind in the mold and the spaces formed by them will be open.

By using, with a mold according to the invention, moveable wall parts, furthermore, undercuts, openings and the like can be provided in the different wall parts of the holder, for instance handles, attachment openings and the like.

Preferably, a mold according to the invention is designed for forming holders with a relatively small wall thickness relative to the bottom surface and longitudinal wall thereof, while the holder is relatively deep with regard to the dimensions of this bottom surface. Especially with such a holder, it is advantageous when during injection of the plastic the flow paths are relatively short and wide, while, only after the plastic has been introduced into the mold cavity at least for the larger part, it is brought to its final form, to be completely filled with plastic. The fact is that during the movement of the wall parts, the plastic will only have to travel a relatively short flow path.

In a further advantageous embodiment, a mold according to the invention is further characterized in that also for at least a part of the bottom surface of the holder, a moveable wall part has been provided. With this, the advantage can be achieved that the plastic can be introduced into the mold cavity with even less pressure. Preferably, this respective moveable wall part has a direction of movement approximately parallel to the first direction of movement.

It is preferred that for each moveable wall part, in particular for each wall part moveable in a second direction, drive means are provided. Preferably, these are controllable independently of the movements of the mold parts in the first direction. As a result, each time, the moveable wall parts can be moved optimally. Preferably, the moveable wall parts are arranged for movement with a fully closed mold, but can also be designed such that they can already move upon closure of the mold. In the latter case, plastic will have to be prevented from flowing between the closing surfaces of the mold.

The invention further relates to an assembly of a press and a mold according to the invention, characterized by the features of claim 12.

The invention further relates to a method for forming holders and such products, such as crates, containers and other products with at least one space open towards the surroundings. According to the invention, such a method is characterized by the features of claim 14.

With such a method, which is preferably carried out with the aid of a mold according to the invention, the possibility is presented to form holders with relatively complex and/or large dimensions, with relatively small wall thicknesses and on relatively simple, light machines. With such a method, injection pressures and closing forces are relatively low with respect to those used in conventional injection molding techniques, while, moreover, a larger design choice is obtained. Further, with a method according to the invention, holders can be formed from a larger variety of materials, among which plastics with a low melt.

With a method according to the invention, the or each moveable wall part can be moved during introduction of the plastic, which can for instance be advantageous with plastics with a critical solidification range or, for instance, with crystalline plastics, so that these can be kept transparent. Also, with this, material properties of the plastics can be prevented from being adversely influenced. It is noted, for that matter, that since the plastic is introduced with an already low pressure, stresses in the plastic can be prevented for the larger part, at least be reduced, so that the holder will not contain much stress.

Alternatively, the or each moveable wall part can be moved after the plastic has been introduced, at least substantially, into the mold cavity, for instance at a filling of approximately 80%. As a result, the counter pressure upon injection remains low longer. It is then preferred that each moveable wall part is moved rapidly such that as a result of, primarily, friction in the plastic or between plastic and mold parts and/or compression of the plastic, adiabatic heat development occurs in the plastic. As a result, the viscosity of the plastic is reduced again or the plastic even becomes liquid again, so that it can effect a complete filling of the mold cavity even better and in an even simpler manner.

Naturally, also, combinations of the above-described movements can be used. Preferably, the plastic is introduced near or in a bottom surface of the holder. As a result thereof, problems in the flow and in particular in confluence of the plastic can be prevented at least for the larger part.

In the further subclaims, further advantageous embodiments of a mold, assembly, method and product according to the invention are described. In clarification of the invention, embodiments of a mold, assembly, method and product according to the invention will be further elucidated with reference to the drawing. In the drawing:

Fig. 1 shows, in top plan view, a holder according to the invention, shown here as a crate;

Fig. 2 shows, in cross-sectional side view along the line II-II in Fig. 1, a holder according to the invention;

Fig. 3 shows, in cross-sectional side view, a mold according to the invention, placed in a press, in closed condition with a mold cavity with maximum volume, i.e. with moveable wall parts in a retracted position, cross-sectioned along a plane corresponding to the section of the holder as shown in Fig. 2;

Fig. 4 shows the mold according to Fig. 3, with moveable wall parts moved forward; and

Figs. 5 and 5A show, in cross-sectional side view comparable to Figs. 3 and 4, a mold according to the invention, in an alternative embodiment.

In this description, identical or corresponding parts have identical or corresponding reference numerals. In this description, as an example, a crate, will be described, in particular a crate for bottles. However, the invention should not be taken as being limited thereto. Many other holders, provided or not provided with compartments, with all sorts of differently shaped bottom surfaces such as circular, rectangular, square, or with a different shape are possible within the framework of the invention. Also, holders can be formed with and without cavities in the side walls and/or bottom. Further, other products too can be manufactured in the same or a comparable manner, for instance partly hollow, plate-shaped, rod-shaped, tubular or differently shaped products. The products can have (a) longitudinal wall(s) being at right angles to a bottom surface, but the or a longitudinal wall thereof can also be at an inclination relative to this bottom surface.

In a mold and method according to the invention, different plastics can be used, in particular thermoplastic plastics and blends. Crystalline plastics too and mixtures thereof can be used particularly well within the invention.

Fig. 1 shows, in top plan view, a holder 1 according to the invention, in the form of a bottle crate, to which the invention is not limited. Fig. 2 shows the holder 1 in cross-sectional side view. This holder 1 comprises a bottom surface 2 and a longitudinal wall 3 extending away therefrom. The longitudinal wall 3 is substantially double-walled, which means that it

comprises a first wall 4, a second wall 5 and, located therebetween, a cavity or open space 6. The wall thickness Dw is relatively small relative to the dimensions A, B of the bottom surface 2 and the height H. The wall thickness can be, for instance, between some tens of millimeters and some millimeters, depending on, for instance, the holder dimensions, intended use and the like. Between the walls 4, 5 cross partitions 7 can be provided, preferably with a comparable wall thickness for rigidifying and increasing the bearing capacity. Within the longitudinal wall 3 and the bottom surface 2, an inner space 8 with a compartmentation is provided by cross walls 10. They reach to a point below the upper side 11 of the longitudinal wall 3. The top ends of the walls 4, 5 are interconnected by a carrier edge 12, preferably with a wall thickness comparable to that of the walls 4, 5. In the bottom surface 2, openings 13 can be provided, for instance circular, as shown at the bottom right-hand side, or formed by cross bars 14, as shown at the top right-hand side. Due to the provision of openings, material and weight, cooling time and/or closing pressure can be limited. In the longitudinal wall 3 handles 15 are provided at opposite sides.

A holder 1 according to the invention can for instance be manufactured in a mold 20 according to Figs. 3 and 4. This mold 20 is included in an injection molding device, at least press 21 known per se, parts of a fixed table 22 of which, and a table moveable in relation thereto in a first direction of movement S are shown. The mold 20 comprises a first part 24 arranged on the fixed table, and a second part 25, moveable relative thereto and attached on the moveable table 23. Naturally, the first direction of movement S can have any orientation, for instance vertically as shown in Figs. 3 and 4, but also horizontally, by tilting the press 21.

The first part 24 comprises a central core part 26, for forming the internal space 8 of the holder 1. This central core part 26 is surrounded at all sides at a distance D1 by a second core part 27 provided on the first part 24 of the mold 20. The distance D1 corresponds to the wall thickness D of the first

wall 4 of the holder 1. The second core part 27 corresponds in shape to the shape of the cavity 6 in the longitudinal wall 3 of the holder 1. Optionally, in the upper side of the second core part 27, pins 28 can be provided which fit into recesses in the second part 25 of the mold 20, for support thereof. As a result, openings are formed in the edge 12. Between a leading end 29 of the central core part 26 and the first part 24, a space 30 is left open for forming the bottom surface 2. In this space 30 a supply opening 31 terminates through which plastic can be introduced into the mold cavity 32.

At the side of the second core part 27 facing away from the central core part 26, in the embodiment shown on four sides, a moveable wall part 33 is provided in the form of a slide 34 which is moveable in a second direction of movement C. The surface facing the second core part 27 has the form of the outside of the respective part of the longitudinal wall 3. Optionally, on the slide 34, a projection 35 can be provided for forming the handle 15, which projection, to that end, can reach through an opening 36 into the second core part 27. For the sake of simplicity, projection 35 and opening 36 are only drawn on the right hand side.

In the position shown in Fig. 3, the slides 34 are shown in a retracted position, i.e. at a distance D2 from the second core part 27 which is greater than the desired wall thickness D3 of the second wall 5. Therefore, between the slide 34 and the adjoining core part 27, a relatively great, wide space 37 is provided, through which plastic can flow in a simple manner without much resistance.

At the rear side of the slide 34, inclining surfaces 38 are provided, in the embodiment shown two surfaces 38 inclining in opposite directions. Further, a flat running surface 39 is provided behind the slide, i.e. at the side thereof facing away from the second core part 27. Between the inclining surfaces 38 and the running surface 39, wedges 40 are provided with corresponding inclining surfaces 38A and running surfaces 39A. The wedges 40 are connected with drive means 41, in Figs. 3 and 4 designed as piston-cylinder assemblies

42, with which the wedges 40 can be moved from a first position shown in Fig. 3 to a second position shown in Fig. 4, and vice versa. By moving the wedges 40 to the second position, the slides 34 are moved inwards, i.e. towards the second core part 27. Consequently, the space 37 is reduced and with it, plastic present therein is forced away and/or somewhat compressed.

A mold 20 with press 21 can be used as follows.

The mold 20 is brought into the closed position shown in Figs. 3 and 4 and held closed by the press 21 with a relatively light closing pressure. The closing pressure is smaller than necessary for injection molding a similar holder with the aid of conventional injection molding technique and mold, which, customarily, can be defined from, substantially, the projected surface in the direction S, the flow paths, in particular the wall thicknesses, and the plastic used.

The slides 34 are brought into the retracted, first position, whereupon, via the supply opening 31, with the aid of means 31A suitable thereto, plastic is introduced into the space 30, preferably in melted, at least in substantially liquid form. From the space 30, the plastic flows via the spaces 30A between the central core part 26 and the second core part 27 over the second core part 27 into the spaces 37. Since the plastic in the spaces 37 experiences hardly any resistance, it can easily flow as far as in there without undesired pressure build-up and/or solidification of the plastic. Then, when substantially all necessary plastic has been introduced into the mold cavity 32, the driving means 41 are energized, so that the wedges 40 are moved to the second position and the slides 34 are forced in the direction of the second core part 27. Consequently, the plastic is forced further into the mold cavity 32, in particular up to the end of the space 37, for complete filling thereof.

As the direction of movement C includes an angle with the direction of movement S, a favorable load of the different parts is obtained. As the plastic can flow into and through the mold cavity 32 without much resistance, relatively low pressures will suffice. As a result, for instance, bending of the

second core parts 27 and excessive wear are prevented. Moreover, as a result of this too, the necessary closing force can be kept low.

After the slides have been moved forwards maximally, the plastic can solidify and after, optionally, the slides are pulled back and the mold 20 is opened, the holder 1 can be taken out. As a result of the relatively low injection pressure, the product will be virtually stressless.

In Figs. 3 and 4, for clarity's sake, the openings for forming the partition walls 10 are omitted.

The slides 34 of a mold 20 can be moved so rapidly that in the plastic, adiabatic heat development occurs. As a result, the flow properties of the plastic can be further improved and, plastic which has possibly solidified, can be made liquid again. Alternatively, the slides 34 can also move slowly, so that the plastic is not heated or only to a very limited extent and already slightly solidifies during introduction. Also, the possibility exists to move the slides during introduction of the plastic already in the direction of the second position (Fig. 4) so that the plastic is continuously held in motion. This can be advantageous in particular with, for instance, crystalline plastics and plastics with a glass transition point and/or a low melt or when product properties of the plastic have to be accurately maintained.

In Fig. 5, schematically, a mold 20 is shown, in an alternative embodiment. This mold 20 is suitable for forming a substantially frustoconical holder 50. In this embodiment, the first core part 27 comprises two slides 51, moveable in a second direction of movement C. Between the first slides 51, a first wedge 52 is included which, with the aid of a drive means 41, for instance an electrically drivable screw spindle 53, is moveable in the first direction S. Upon downward movement of the wedge 52 (in Fig. 5) the first slides 51 are moved outwards, to a product-forming second position. At the outside of the mold 20, at least of the mold cavity 32, second slides 54 are provided, drivable by, for instance, driving means 41 in the form of piston-cylinder assemblies 55, between a retracted, first position and a second position, moved forward.

Below the mold cavity 32, a third slide 56 is provided, moveable in the first direction S with the aid of drive means 41 in the form of for instance, again, a piston-cylinder assembly 57.

In Fig. 5A, the different slides 51, 54 and 56 are shown in the retracted, second position, in Fig. 5 in the first position, moved forward, both around a holder 50. As clearly appears from the Figures, in the slides, in particular in the first slides 51, undercuts 59 may have been provided, for instance in an edge area thereof, so that projections 60, backs, grooves or the like can be provided in the holder which, otherwise, would not be clearing. In the bottom surface 2 of the holder 1, a narrowed portion 58 is provided through pushing the third slide 56 further.

It will be clear that the invention is not limited in any manner to the exemplary embodiments given in the drawing and the description. Many variations thereon are possible within the framework of the invention as outlined by the claims.

For instance, in a mold according to the invention, other numbers and/or other forms of slides, at least moving wall parts can be provided, which can for instance also be designed so as to be tilting. Different types of drive means can also be provided. The mold parts 22, 23 can be moved and be held closed in a different manner, while also multiple molds and/or stack molds can be built up in a comparable manner. It will further be clear that the first and second direction of movement can also include other angles than those shown of approximately 90°, while the directions of movement for different slides can also be different. The movements of the wedges and slides can have any desired orientation, as long as the first and a second direction of movement mutually include an angle. Also, other sorts of products can be manufactured with a mold, at least an assembly according to the invention, for instance relatively small and/or low products, tubular products and the like.

These and many comparable embodiments are understood to fall within the framework of the invention as outlined by the claims.